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Implementation of a Telegram chatbox and web platform for hypertension

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Abstract

Introduction Hypertension is a disease that if not treated properly can cause serious symptoms or even, depending on the case, can lead to death. That is why a telegram bot has been created so that users suffering from this disease can inform their doctor of the blood pressure taken in their own home and thus facilitate communication between doctor and patient. In addition, it is also more comfortable because it is possible to avoid going to the doctor's office just to give those values.
Objective Develop a useful, easy to use, robust and efficient web application and, mainly, help the user to be able to communicate with their patients and adapt to the particular requirements of the arbitration. Develop an easy to use telegram bot that allows patients to send their information.
Methods The usability, robustness and efficiency factors of the web application were evaluated for different devices and operating systems (Windows, iOS). **Results** After evaluating the different factors and analyzing them to obtain even more positive results, the application behaved well in the face of these factors.
Conclusions It is an application that has and will have a great potential due to the comfort it gives to its users both to receive information and to send it. In addition, with the current situation it is the safest for both health personnel and patients.

Keywords: Hypertension, eHealth, Applications, Mobile, Telegram

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1. Introduction

Currently, one of the diseases that is most present in society is high blood pressure. Hypertension is a chronic pathology in which the blood vessels have a persistently high tension, which can damage them. Blood pressure is the force that blood exerts against the walls of the vessels (arteries) when it is pumped out by the heart. The higher the pressure, the more effort the heart has to make to pump.

One of the characteristics of this disease is that it does not present clear symptoms and these can take a long time to manifest themselves. However, it is the most prevalent cardiovascular risk factor.

At present, cardiovascular diseases are the leading cause of death in Spain.

The first consequences of hypertension are suffered by the arteries, which harden as they bear the high blood pressure continuously, become thicker and can be difficult to pass blood through. This damage to the walls of the blood vessels favors the deposition of cholesterol and triglycerides in them, thus making hypertension a very significant risk for the development of arteriosclerosis.

1.1. Motivation

As described in the previous point, cardiovascular diseases are the main cause of death in Spain, especially in middle-aged and elderly people.

And the fact is that hypertension is not far behind in these data. Not treating this disease properly and at the right time can have serious consequences for the patient.

Blood pressure readings are usually given as two numbers. The higher number is called the systolic blood pressure. The lower number is called the diastolic blood pressure. For example, 120 over 80 (written as 120/80 mm Hg).

A normal blood pressure is when the blood pressure is less than 120/80 mm Hg most of the time. A high blood pressure (hypertension) is when one or both of the blood pressure numbers are greater than 130/80 mm Hg most of the time. If the top number of your blood pressure is between 120 and 130 mm Hg and the bottom number is less than 80 mm Hg, it is called high blood pressure.

There are many causes that can affect blood pressure, including the amount of water and salt you have in your body, the condition of your kidneys, nervous system or blood vessels, or hormone levels.

The effect of hypertension on our body is extensive and very dangerous: it can range from damage to your heart, brain, kidneys or even your eyes among other symptoms.

That's why it is obvious that this disease is very dangerous and that's why we have chosen to create a web application exclusively for this pathology that allows doctors to control their patients, including controlling their blood pressure, such as having a clinical history of the patient. In addition, to lighten the process and not have to force the patient to visit the medical center of reference, a telegram bot has also been created that allows the doctor to communicate with his patient.

Moreover, seeing the health situation that unfortunately exists around the world today, it is obvious that it is something positive for all actors in the system since it allows both the doctor/nurses or patients to communicate safely and not expose themselves to the COVID-19. On the other hand, currently medical visits have been restricted in a remarkable way so it is another positive factor to take into account.

1.2. Contributions of Hypertension project

In the scientific community there are several applications for mobile devices that allow to control the user's blood pressure after entering the user's data. There are even scientific books or magazines that help readers to maintain a balanced and healthy diet to prevent this type of disease or even to live more optimally when the person unfortunately has the disease. Hypertension project goes a little further.

Although it is true that the essence and operation is similar to the applications that exist on the market (and that will be mentioned later), this project allows a close, direct and confidential relationship with the doctor of reference of each user. The project is designed to be used in hospitals so the use would be more professional. The patient, when taking his pressures at home, enters them in the telegram bot that has been created and this automatically enters the data into the system used by the doctor for further data processing. That's why this project goes a little further and is more professional.

In addition, the program can also be used routinely for the medical worker. That is, you can also save clinical visits made by the patient, send notices to patients, change patient data, etc.

Below are the main features of Hypertension Project:

- Compatible web application for Windows and Mac and compatible Telegram bot for Android and iOS.
- Supported languages: Spanish, Catalan and English.
- Telegram bot for the patient to communicate with the doctor.
- The bot can send warnings to the patient at the time it is his turn to send the blood pressures.
- Simple and easy to use web application for the doctor to manage his patients.

2. State of the art

Below we present the most outstanding scientific works, presented in congresses and conferences that have some relation with Hypertension project.

- *Remote Decision Support System for Diagnosis of the Arterial Hypertension [1].* The article describes general structure and results of the experimental approbation of the remote decision support system for diagnosing of arterial hypertension. Core elements of the system are database, for storage and remote access to the data, and algorithms of the decision support, based on the features sets of the heart rate variability signals. Results of experimental approbation have shown that among 5 diagnostically significant features sets, 2 have a decent potential for a generalization.
- *Importance of image processing in digital optical capillaroscopy for early diagnostics of arterial hypertension [2].*The main idea of the study was to determine the applicability of digital optical capillaroscopy for the diagnostics of early stages of arterial hypertension. Diameters of the arterial and venous segments, perivascular zone size, capillary blood velocity, the degree of arterial loops narrowing and the density of the capillary network were estimated using original software.
- *Heart rate variability analysis for arterial hypertension etiological diagnosis during surgical procedures under tourniquet [3].* Pneumatic tourniquets are widely used to provide a bloodless operative field during upper or lower limb surgery. If tourniquet inflation during general

anesthesia is initially a mild stimulus, a long duration of inflation can imply heart rate and blood pressure increasing. However, heart rate or blood pressure increasing can also be caused by other external stimuli.

- *Peculiarities of red blood cells aggregation and deformability in patients with arterial hypertension: assessement with optical techniques [4].* Red blood cells aggregation parameters is assessed with optical techiques: diffuse light scattering, optical trapping and manipulation and capillaroscopy. Peculiarities of the cells aggregation and its effect on capillary blood flow in patients with arterial hypertension are discussed.

- *Remote Health Monitoring System for a Patient with Arterial Hypertension and Cardiac Arrhythmias [5].* The article is devoted to the system of remote monitoring of the patient's health with arterial hypertension and cardiac arrhythmias. The structure and principle of operation of such a system are presented.

- *Arterial hypertension: oxidative stress and endothelial dysfunction [6].* The aim of the study was to investigate the pathogenetic significance of oxidative stress (OS) in the development of endothelial vascular dysfunction (ED) in essential arterial hypertension (AH) and to determine the possibilities of the markers usage for evaluation of antihypertensive drugs influence on leukocyte-endothelial interaction (LEI).

- *Processing and Analysis of the Results of Long-Term Continuous Monitoring of the Health Status of Patients with Arterial Hypertension and Cardiac Arrhythmias [7].* The article deals with processing and analysis methods of the results of long-term continuous monitoring of the health status of patients with arterial hypertension and cardiac arrhythmias. The developed system of indicators is presented, which must be taken into account when processing and analyzing the results of long-term continuous monitoring of the patient's health, as well as algorithms for supporting decision-making by a doctor in the treatment of patients with arterial hypertension and cardiac arrhythmias.

Currently, there are apps in the market dedicated to the world of blood pressure. The following are the most significant apps available in *app-stores*, related to blood pressure, similar to the functionality provided by Hypertension project.

- *Registro de presión arterial [8].* This application automatically calculates the blood pressure zone, supports blood pressure zones, is useful for controlling blood pressure and easy to use for BP monitoring and tracking application.

- *High Blood Pressure Diet Tips [9].* App covers information about High Blood Pressure Hypertension such as Types causes risk factors friendly foods and foods to avoid etc. Dieting ideas and tips of this app have been carefully reviewed by Experienced and professional dietitians carefully.

- *Hypertension: Causes, Diagnosis, and Management [10].*This app helps to understand the Hypertension Guide, Hypertension Disease Management & Hypertension Disease causes.

- *Hypertension [11].* Like most applications, it helps keep the user informed about this disease, its most common causes, its symptoms and actions to prevent it.

- *Presion Arterial - Tensión, Pulso Diario* [12] This application allows the user to enter their blood pressure data in the same way as they enter their pulse in order to maintain control.

As we have seen in these multiple examples of scientific articles and applications, there are several applications that allow the user to enter the data of his blood pressure as well as to enter his pulse, in the same way that there are also applications that give useful information to the user about this disease but it is also true that none is similar to the point of this project since it allows the user to communicate directly with his doctor and thus avoid having to go to the doctor's office and lighten the whole process.

In short, there is no article or application that resembles the full functionality provided by Hypertension project.

3. Objective

The goal is to design a web application that can be used for doctors' daily routine and that above all is useful, robust, efficient, usable, simple and easy to use. In the same way, it also aims to design a telegram bot that is easy to use for everyone, whatever their profile. Hypertension project is designed so that medical staff can receive more information and feedback from patients from their own home and have a faster, safer and more personalized attention with each patient. In addition to all this, medical staff can also record all patient visits as well as generate alerts, charts or even view and edit patient data.

In the same way, the patient will be able to communicate in a more comfortable and quicker way with his doctor and thus have to avoid short and unnecessary medical visits and avoid the risk of contagion that we are currently experiencing.

Hypertension project has been developed entirely by the University of Lleida for electronic devices with Android and iOS operating systems (Telegram bot) and for any desktop device (web application). Hypertension project communicates with Telegram API in order to receive and send bot requests and to register, consult or send warnings to users.

4. Tecnology

The following section explains the technology that has been used in the development of the project, both in the application part and in the Telegram Bot.

4.1. Application

For the development of the web application IntellIj has been used as a development environment. IntellIj supports many languages such as Java, Python, Kotlin, Groovy, Javascript, Typescript, Php, Haskell, etc. In addition, this development environment also allows you to synchronize the project with GitHub so you can work more optimally.

In our case it has been decided to use Groovy as a programming language and the Grails framework. Grails is a development framework for web applications created in Java and Groovy in 2005. But it is also a tool for building projects and testing at the same time, which also allows the addition of third party developer plugins. It has the peculiarity of covering the three

layers of web development: database access, business layer and view. And to achieve all this in a single product, Grails is based on other (many) known opensource frameworks: mainly Spring and Hibernate.

The main and most striking feature of Grails is that it is designed for us to program the applications in Groovy, a dynamic language with the same syntax as Java, but which adds many new features, allowing us to program more with less code.

That's why we have chosen to use this framework. First of all because it is compatible with Spring and Hibernate, two frameworks that make life much easier for developers in terms of database access. On the other hand, it is compatible with MongoDB (database of choice) and allows you to create all the entities automatically in the database by simply compiling and running the program.

4.2. Telegram Bot

Telegram bots are a series of third-party applications that run within the messaging application. You don't need to install them or do anything else to use them, since they are integrated in such a way that they are used as if they were a real person you are interacting with. They are multiplatform, and you can use them in the Telegram version of the operating system you want.

The interface of these applications is purely textual, and you will control them by sending them messages containing certain commands or instructions that they understand to react to them. The commands, instructions or words you have to write to them to use them will depend on each bot.

These applications are fully automated. There is no one behind them, but they are prepared to give certain types of responses depending on the command you write to them. You can find several types of bots, from simple ones that simply show basic content to others that are more complex and focused on a specific task that they can help you with.

In our case we have used the "java-telegram-bot-api" extension that allows developers to wait and send Bot requests through Webhooks. A webhook is, to say the least, an automatic communication system between apps. What they do is provide a simple solution for exchanging data between web applications, or even between our website and those applications.

In a manner of speaking, the Webhook would be the intermediary between our web application and the Telegram API, which, together with the

aforementioned extension, allows us to communicate and send and receive requests.

4.3. Database

The database used is MongoDB. This database has been used because it provides a great backup for those applications that require massive data, as could be this project by the large number of patients and in turn, their respective data. In addition, it is known that MongoDB is non-relational and document-oriented, so it provides a number of advantages such as document validation, integrated storage engines, and reduced recovery time in the event of failures. It is also more flexible since as it is document-oriented, the term "data type" is not as strict.

In addition, as of version 4.0, MongoDB introduces the term transactionality. A transaction, on the other hand, is a set of orders that are executed forming a work unit, that is, in an indivisible or atomic form.

The main entities of the BBDD are: Patient, ClinicalHistory, BloodPressure, PatientAptitude, MonitoringForm and Organization.

- Patient: represents the patient of the entity.
- ClinicalHistory: represents the patient's clinical history.
- BloodPressure: represents the blood pressure values.
- PatientAptitude: represents the patient's attitude towards the disease..
- MonitoringForm: represents the follow-up of the patient..
- Organization: represents the different organizations that exist in the system.

Below is a diagram with the main tables of the database. On the one hand, we see that an application user will have at least one role and may have several and at the same time have an organization to which he belongs.

On the other hand, a patient will always have 0...N clinical histories, blood pressures and monitoring controls but will have 0 to 3 aptitudes because of the cell phone and email alert theme.

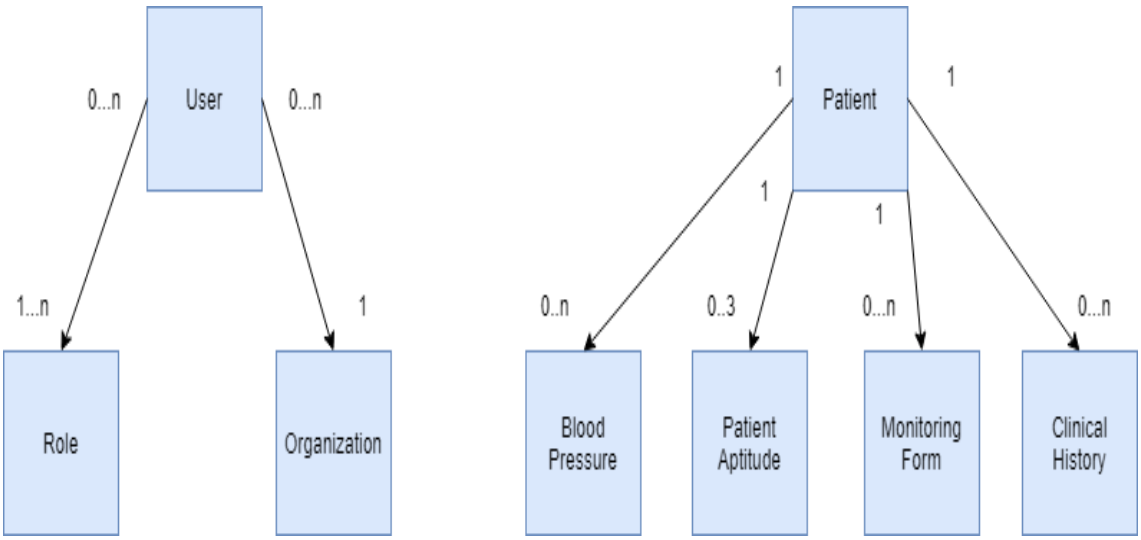

Figure 1: Database.

5. Characteristics of Hypertension Project

5.1. Creating a patient

One of the main features offered by the Hypertension Project is the creation of new patients. It is an obvious fact that is very important for the application because for each new patient that the doctor in question has, he or she will have to make a new record in the patient creation form for its later visualization in the list (next point).

Therefore, Hypertension Project has a registration process, which is a prerequisite for the use of patient management (see Figure 2). The following fields are required for the patient to be registered:

- Mode: in this drop-down list the user can choose if the user is registered in active mode or not.
- DNI: the DNI must be introduced, being this unique.
- Date of birth
- E-mail: e-mail is required to, among other things, send alerts or graphics of interest to the patient.
- External ID

- Name
- First and second surname
- Sex
- City and town
- Mobile phone: also useful for sending alerts
- Language

The application always checks that all fields have been filled in, that the email address DNI and mobile have a correct format. If so, the application sends a POST request and saves the corresponding data in the database. Also, at the beginning of the form there is a button called "Fitness Screening" that opens a pop up that indicates how the user wants to be alerted (if he wants to). By email, phone or both.

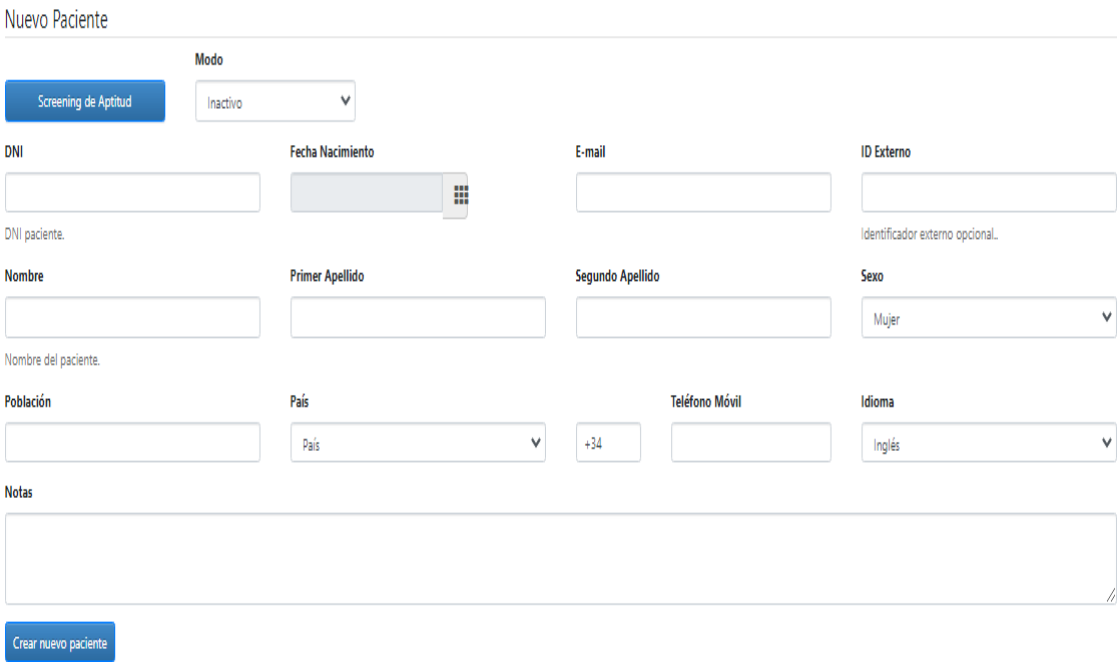

Figure 2: Create a patient.

5.2. Patient Listing

One of the main functionalities of Hypertension Project is that the user who is using the system at that moment, that is, the doctor in question, can see which patients he or she has discharged into the system for later work with them.

As you can see in the figure 3, we have an example of a user of the application on that screen.

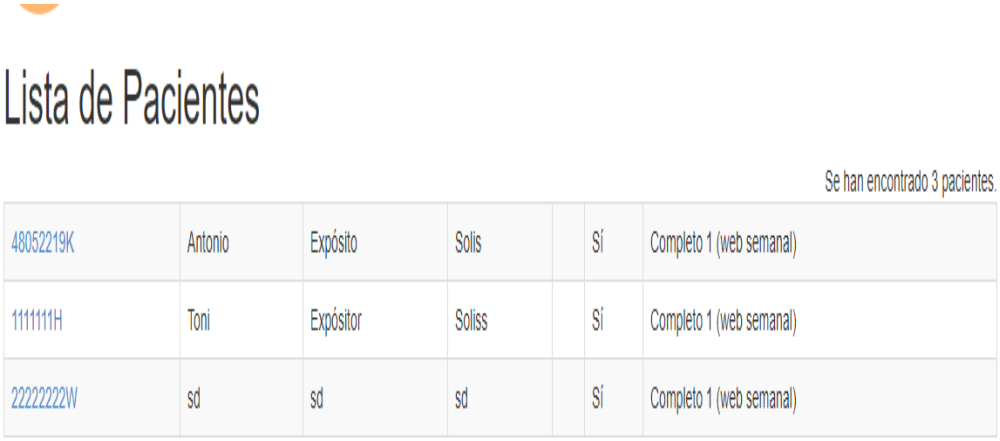

Figure 3: Patient listing.

In the example image we can see how this user has 3 different patients associated with his account. In the table, the user can see the patient's full name, his/her ID, whether the patient is active or not, and how often the user is given several alerts (which are configured in the patient registration process).

5.3. User profile

As in any application today, in Hypertension Project there is also a user profile part. In this screen the user who is connected to the application can consult various user data and can even modify them.

As you can see in the figure 4, the user profile screen is a very extensive and diverse screen where you can navigate through practically all the important features that the project has. You could say that this screen is the core.

As you can see, in the center of the screen you can see how the data entered by the user in the patient registration process are inserted as well as a profile photo (if any) and the current status (in reference to hypertension). In addition, as mentioned above, there is also a button to edit the user and another to delete it.

And to finish, a little above the above mentioned you would have the user menu. That is, several tabs where the most important features of the application are centered, which will be discussed below.

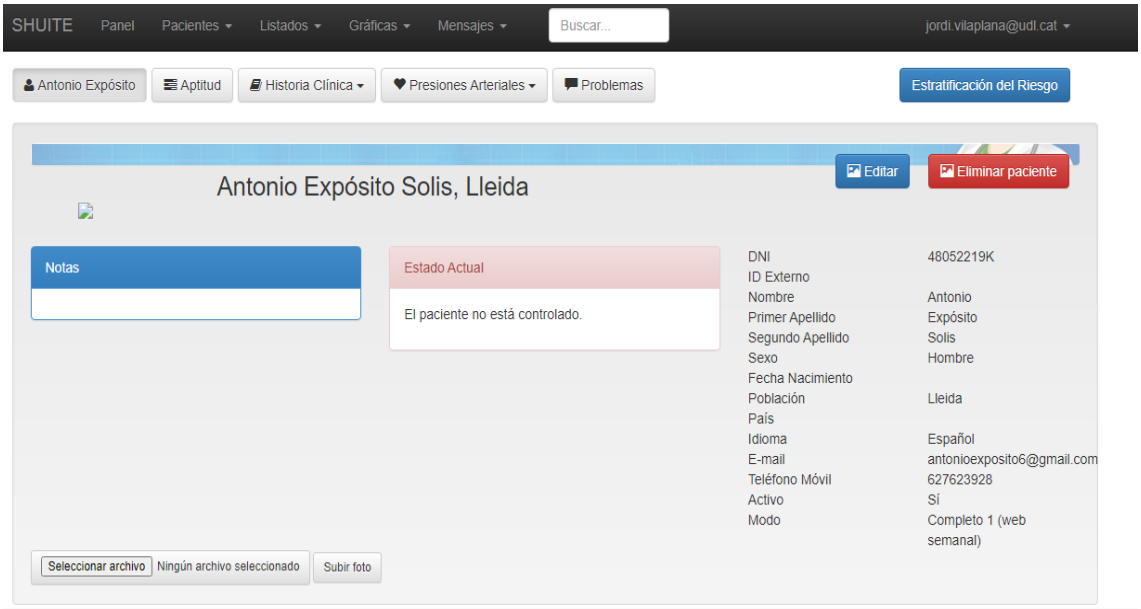

Figure 4: User profile.

5.4. Aptitude screening

Another important functionality is aptitude screening. At first glance it may seem like just another screen and its functionality is simple and insignificant, but it is not for this project.

If we look at it, on the one hand it asks if the patient has a personal cell phone and if he or she knows how to use mobile messaging (i.e. send and receive messages). On the other hand, it also asks if the patient's mobile is a smartphone. These two questions are important since they are essential for the use of the Telegram Bot. If the patient does not have a smartphone or is simply an elderly person who is not technologically literate, he or she will not know how to use Telegram, much less understand how it works and what a Bot is.

Finally, we also check if the patient has e-mail and consults it daily so that we can send messages or warnings to the patient. Also, the user can modify the value of these questions.

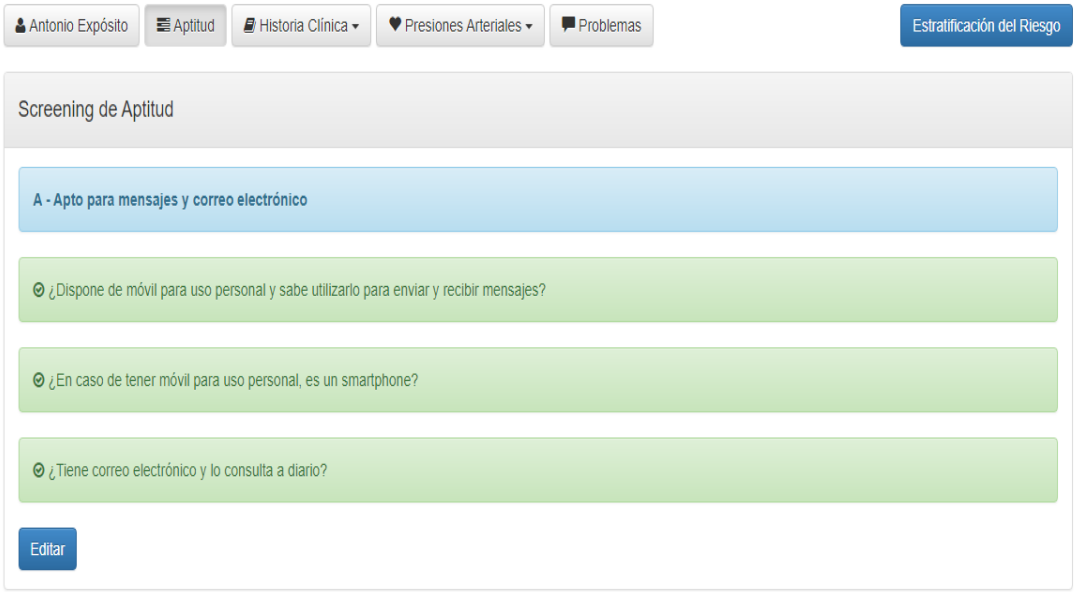

Figure 5: Aptitude Screening.

5.5. Medical history

Another of the most important features of the Hypertension Project is the clinical history and your first visit (see figure 6). Once the user has discharged a patient, evidently all the data related to medical visits, etc. are empty, so this screen represents the first medical visit that the patient has made with his doctor. Therefore, it is the first thing that has to be filled in after creating the patient.

As you can see, there are quite a few fields to be filled in the form, although some are more important than others.

The most important and required fields are weight, height, age, abdominal girth and blood pressure: systolic blood pressure and diastolic blood pressure. Also the initial added risk considered by the doctor.

Then, we have other fields that may also be important but are not mandatory. For example, there is the HTA degree and the date of issue of the visit (although it is filled in automatically) and the added risk factors which are different checkboxes that can be filled in by the doctor in case there are any. Also optional is the tab "Subclinical Target Organs" and "Clinical Target Organs".

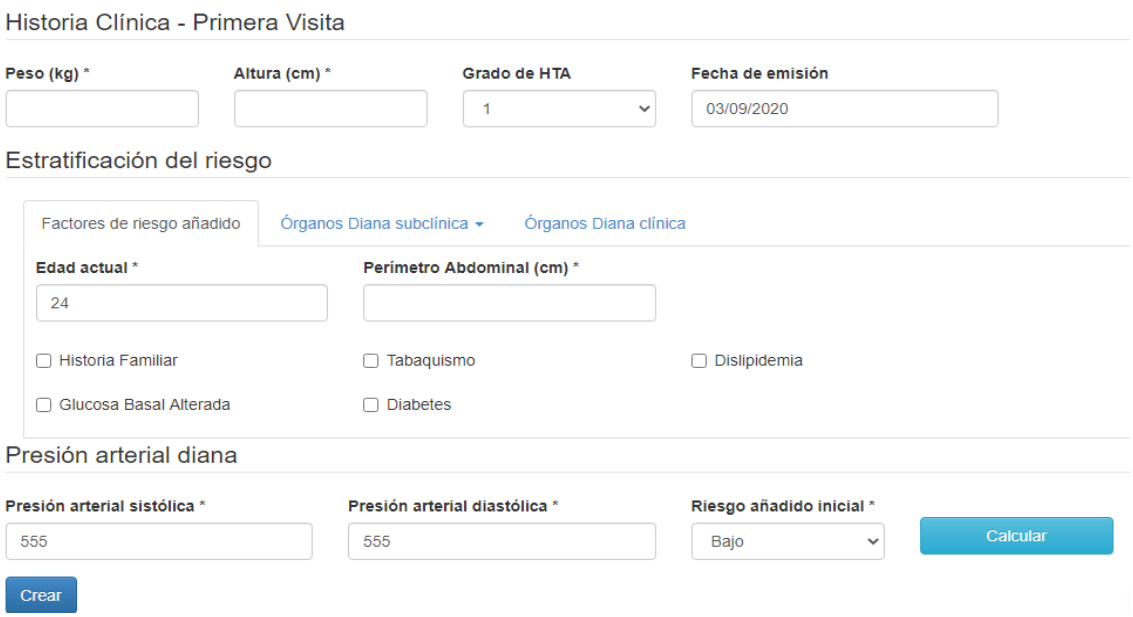

Figure 6: Medical history.

5.6. Blood pressure

As expected, one of the most expected screens is to add the blood pressure, as shown in the image 7.

The screen is easy and intuitive to use. The user only has to insert the data of the systolic pressure, the diastolic pressure and optionally can also enter the pulse and some observations. In addition, the date of the blood pressure record must also be entered but this data is already automatically filled in by the system.

So, when the user hits the "Create" button a POST request is sent and the data is saved in the database.

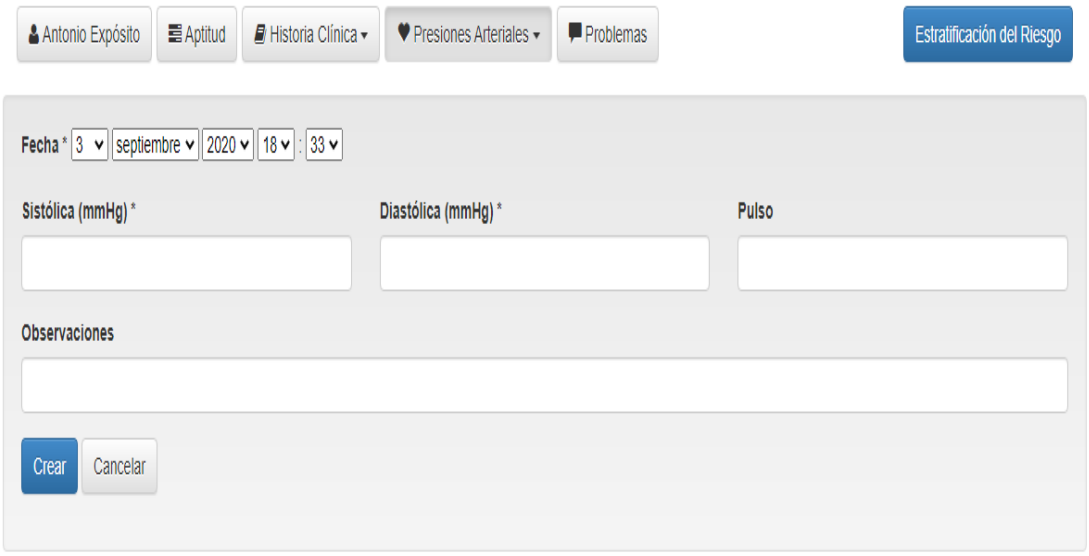

Figure 7: Blood pressure.

5.7. List of blood pressures

As expected, there is also a screen to observe all the pressures that have been introduced from the patient in question. On this screen, the user sees the systolic pressure, diastolic pressure and pulse, type and observations in case it has been entered on the blood pressure insertion screen.

In addition, if the user clicks on the date it has been created, he or she will be able to see that record in detail and be able to modify and delete it.

Finally, if we look closely, there is a button at the top of the list called "Send Web Form" that basically sends the registration form by e-mail so that the patient can send it from home (this is an alternative to the Telegram Bot).

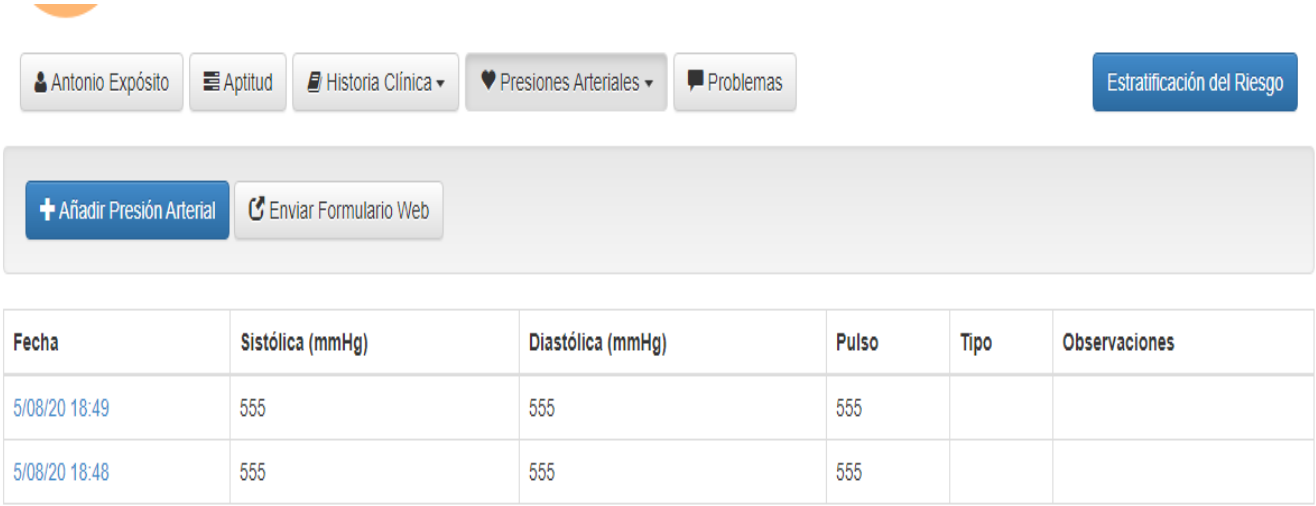

Figure 8: List of blood pressures.

5.8. Treatment

Another of the features of the Hypertension Project is that the doctor can also introduce the treatment he is going to send his patient when he sees fit.

As you can see in the image 9, the procedure is quite simple, as in the screens explained above. The user of the web application must only enter the date of start of treatment (which is marked by default the date that creates the record, but obviously can be modified). Afterwards, the date of the end of the treatment, the family of the treatment and the observations that the user of the application believes opportune must also be introduced.

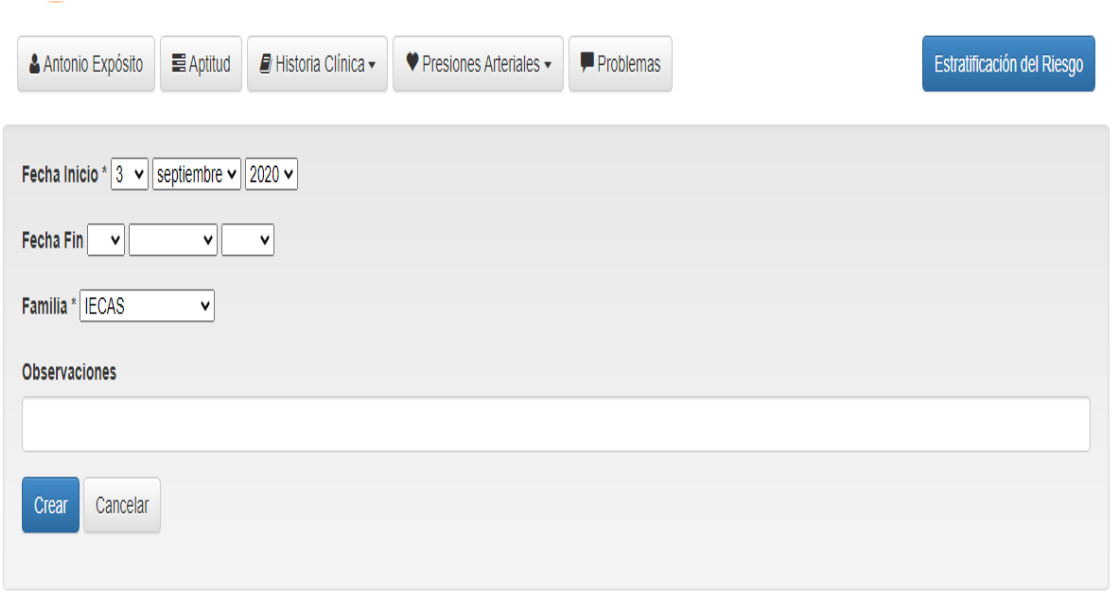

Figure 9: Treatment.

5.9. Risk stratification

The next feature would not be a functionality, it is simply a button and a pop up but it is true that it can be of great help to the doctor when dictating his treatments.

It is a pop up that, according to the values entered for the patient's blood pressure, can determine whether the user is at risk of hypertension or not.

To begin with, the button to access the information mentioned in the previous paragraph can be found in all the profile screens in the upper right part of the screen, as shown in the following image (image 10).

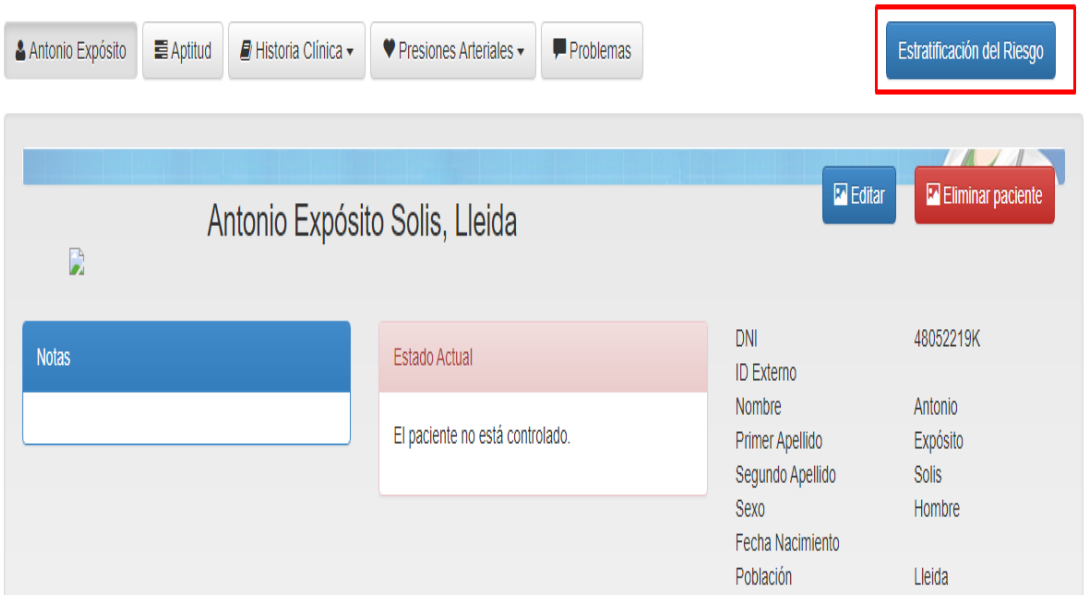

Figure 10: Button.

In the following image (image 11), you can see the pop up shown when the button is pressed. The table shows the intervals between the values of the systolic and diastolic blood pressure and, depending on these values, indicates whether the risk of hypertension is low, moderate, moderate to high or high. It should also be said that these results also depend on other factors such as asymptomatic organ damage or other diseases.

Tabla Estratificación del Riesgo

Otros factores de riesgo, daño orgánico asintomático o enfermedad	Presión Arterial (mmHg)			
	Normal alta (PAS 130-139 o PAD 85-89)	HTA de grado 1 (PAS 140-159 o PAD 90-99)	HTA de grado 2 (PAS 160-179 o PAD 100-109)	HTA de grado 3 (PAS ≥ 180 o PAD ≥ 110)
Sin otros FR		Riesgo bajo	Riesgo moderado	Riesgo alto
1-2 FR	Riesgo bajo	Riesgo moderado	Riesgo moderado a alto	Riesgo alto
≥ 3 FR	Riesgo bajo a moderado	Riesgo moderado a alto	Riesgo alto	Riesgo alto
Daño orgánico, ERC de grado 3 o diabetes mellitus	Riesgo bajo a moderado	Riesgo alto	Riesgo alto	Riesgo alto a muy alto
ECV sintomática, ERC de grado ≥ 4 o diabetes con daño orgánico/FR	Riesgo muy alto	Riesgo muy alto	Riesgo muy alto	Riesgo muy alto

Figure 11: Risk.

5.10. Other features

To finish with this section, it is obvious that there are also other functionalities in the application, although perhaps they are not as relevant as those explained above. However, this does not mean that they are not useful.

For example, in the top menu we have several interesting options. The first of them is "Listings". In this section the user can filter their patients by sex, age, city, etc.

The next one is "Graphics". This section is also interesting as statistics. The user can download graphs of user statistics as well as those mentioned in the previous paragraph.

The next one is "Messages". This section is interesting because the user can send a text message to the email or cell phone of the patient in question as well as send alerts or receive messages from patients.

Finally, we also have the option of changing the user's (doctor's) profile or managing the system's organizations (although the latter already depends on the user's profile).

6. Telegram Bot

Next, we will explain a little about the process of entering blood pressure data by the patient from his home and mobile device through the Telegram Bot.

First of all, if it is the first time that the patient uses the Telegram Bot, he is asked to enter the phone number (which is already entered only by the Telegram API itself) so that the system can detect through the phone number the patient who is connecting to the Bot.

The system then responds to the patient by saying that his number has been correctly recorded and verified and that he can now enter the first data, which is the systolic blood pressure.

Once this value has been entered, the diastolic blood pressure is requested, followed by the pulse. Once this process has been completed, the system informs the patient that the data has been correctly recorded in the application. At this point, the doctor of the web application can already see these values in the system.

Thus, when the patient writes to the Bot again and it is with the following command /pressure, this process will be repeated except for the telephone number, since it is already registered and validated in the system.

Figure 12: Bot Telegram Process (1).

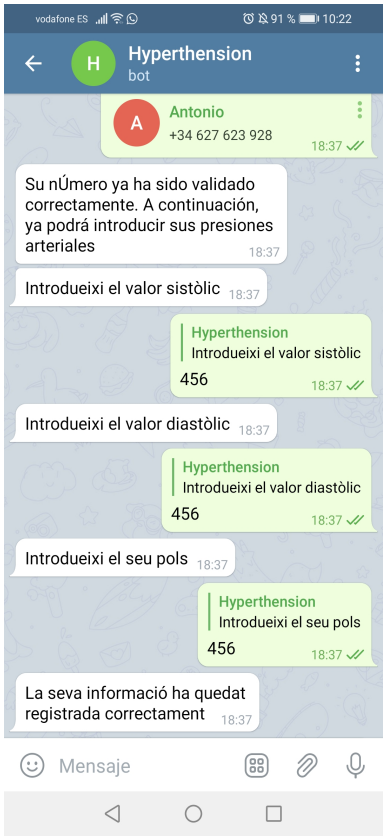

Figure 13: Bot Telegram Process (2)

7. Analysis

The robustness of the Hypertension Project was measured first. Then, the usability and efficiency of Hypertension Project was also evaluated.

To make a rigorous evaluation of the **robustness** of the application, a tool has been used that allows the control of the locks that occur when using the application. This tool is called *Crashlytics*. This tool allows you to monitor users who are active in real time, send customer betas and provide comprehensive information on blockages when they occur, among other things.

To measure the **usability**, a Hypertension Project test was conducted with 30 randomly selected users (students, friends, family). The changes made after their observations made Hypertension Project a great and easy to use application. People had to perform various actions within the application,

such as searching for a specific patient, creating a new training, adding a blood pressure, etc. They also rated the user experience of ReFeree between 1 and 5.

The efficiency parameters measured were **start-up**, **comunication** application-Telegram Bot. The **start-up** time is defined as the time elapsed for an application to start. The **communication** between the application and the Telegram Bot is defined as the average response times, such as from the time the user enters his data until the application receives that information. These times were the average of 3 different measures. Times of less than one second ensure that the user's line of thought remains uninterrupted [13].

8. Results

8.1. Robustness

Crashlytics detected a total of 54 blockages during the ReFeree debugging period (approximately 1 month). Most of them occurred when loading data (35 %), receiving information from the Telegram Bot (25 %) and generating files (PDF) (40 %). Today, the application is almost free of blockages.

8.2. Usability

The 30 users who evaluated Hypertension Project submitted an average of 1-2 suggestions each. Most of these suggestions were for better visual aspects that facilitate the user the correct functioning of the application. The Hypertension Project user experience averaged 4.1/5.

8.3. Efficiency

Device	**Operating System**	**Time**
Samsung Galaxy J5	Android v. 7.1.1	3,188
Huawuei P30 Lite	Android v. 10	2,321
Huawei P8	Android v. 7.0	3,832
Samsung Galaxy S8 Plus	Android v. 10	2,473
Iphone 7 Plus	iOS v. 11.4.1	0,878
Iphone 6	iOS v. 8.4	1,173

Table 1: Start up (in seconds).

First we evaluated the time of **start-up** of Hypertension Project (Table 1). As can be seen in the table 1, this parameter was calculated on 6 different devices: 4 with Android operating system and 2 with iOS operating system. The behavior in iOS is better than in Android, basically because their processors are much faster. However, the values calculated in Android are also optimal for this feature.

The table 2 shows the samples obtained by obtaining the time **communication** between the web application and the Telegram Bot, with the same mobile devices as in the table 1. As you can see, the results follow the same behavior as in the table above and the results in iOS are better than in Android.

Device	Communication
Samsung Galaxy J5	1,478
Huawuei P30 Lite	1,321
Huawei P8	1,391
Samsung Galaxy S8 Plus	1,373
Iphone 7 Plus	1,056
Iphone 6	1,133

Table 2: Telegram application-bot communication efficiency (in seconds).

9. Conclusions

This article presents a project (Hypertension) that consists of a web application and a Telegram Bot so that patients suffering from high blood pressure can inform their doctors of their medical data without having to visit the office. Hypertension project was implemented in Android and iOS operating systems (Telegram Bot) and desktop applications (web application).

In summary, the robustness, usability and effectiveness of Hypertension Project are very good. It can be seen that in terms of robustness, at first it did have several failures in various requirements of the application but with the passage of time and testing it has been fixed.

In terms of usability, the average was 4.1/5. It can be said that taking into account that it is a project that has just come to light and that really has had few people who have tested it, they are remarkably good marks.

In terms of efficiency, it can be considered that the times also behave well for a project of these characteristics with such a short life span.

We can also conclude that this application may have a great potential in the market, since currently there is no other project that resembles the functionalities explained in this document, that is, it is true that there are applications in the market that help the user to enter his data and "control" that data in a certain way, but in none of them does the user have the option of communicating directly with his reference doctor through a Telegram Bot. In addition, being a Bot is available 24 hours and that makes the user can enter the data at the time that suits you.

Besides, living the situation we are experiencing now, an application of these characteristics can be very good to avoid collapsing medical centers and thus avoid unnecessary queues and possible contagion.

Finally, this is just the basis. From what has been implemented, applications of this style that are combined with a Telegram Bot could also be made for the rest of medicine in the current situation.

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